Horizon 2061
From overarching science goal to specific science objectives

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Horizon 2061 Synthesis workshop
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Planetary Systems
A new class of astrophysical object

Extrasolar Planets Systems

The Solar System

Giant planets Systems

Circumstellar disks

IN SITU MEASUREMENTS

REMOTE SENSING (ASTRONOMICAL OBSERVATIONS)
Diversity: disks as initial conditions

Lifetime

Mass

Haisch et al. 2001

Beckwith & Sargent 1996

Planets and stars nurseries
Looking inside the “Planet Factory”

(courtesy of Henning and Semenov)
GIANT PLANETS SYSTEMS
ORIGINS AND FORMATION
sub-nebulae in the Solar Nebula?
DIVERSITY OF PLANETS

Gas Giants

JUPITER
Satellites: 67
- Molecular hydrogen
- Metallic hydrogen

SATURN
- Hydrogen, helium, methane gas

ICE GIANTS

URANUS
- Mantle (water, ammonia, methane ices)
- Core (rock, ice)

NEPTUNE
- Core (rock, ice)
DIVERSITY OF PLANETS!
Diversity of satellites
Diversity of rings!

Jupiter

Saturn

Uranus

Neptune
How do planetary systems work?

**Gravitational coupling**
operates between planets or satellites, rings, small bodies and/or debris disks, gas and dust clouds and rings and one (or several) central object(s)

**Electrodynamic coupling**
maintains and populates a magnetosphere, drives aurorae, provides energy sources to the planetary environment and regulates the interaction with stellar output and activity

+ collisions, phase changes, chemical reactions, volcanism...
Where to search for Habitable Worlds and for life?

The Solar System: an ideal “habitability laboratory”
The Trappist System
OVERARCHING SCIENCE GOAL

Study the formation and evolution processes leading to the growth of complexity, and ultimately to the possible emergence of life, through the diversity of planetary systems:

(1) the growth of molecular complexity, from the Interstellar medium (ISM) to planetary and moons environments;

(2) the growth of planetary environments complexity, and the conditions under which their evolutionary paths may lead them to become “habitable”.
Studying Planetary Systems

SIX MAJOR SCIENTIFIC QUESTIONS

(a) ORIGIN

(b) FORMATION AND DIVERSITY OF PLANETARY SYSTEMS ARCHITECTURES

(f) DETECTION OF LIFE

(c) DIVERSITY OF OBJECTS

(d) HOW DO THEY WORK?

(e) EMERGENCE OF POTENTIAL HABITATS
Flying to the different provinces of the Solar System

1. The Earth-Moon System
2. Terrestrial planets
3. Giant planets and their systems
4. Small bodies
5. Heliosphere, Solar System, ISM and beyond
Thank you for your attention
Solar System Exploration, today and tomorrow